

RCF:ajs 10/16/06 569295 148422.01
PATENT

Attorney Reference Number 3382-55844-01
Application Number 09/401,068

Amendments to the Claims

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Please cancel claims 1, 13, 19, 21, 25, and 28 and amend the claims as follows.

1. (Canceled)
2. (Currently Amended) A voice compression apparatus, comprising:
 - (a) a superframe buffer for receiving multiple frames of voice data;
 - (b) a frame-based encoder analysis module for analyzing characteristics of voice data within frames contained in the superframe to produce an associated set of voice data parameters; and
 - (c) a superframe encoder for receiving voice data parameters from the analysis module for a group of frames contained within the superframe buffer, for reducing by analysis data for the group of frames and for quantizing and encoding said data into an outgoing digital bit stream for transmission, wherein said superframe encoder includes a bandpass voicing smoother for mapping multiband voicing decisions for each frame into a single cutoff frequency for that frame, wherein said cutoff frequency takes on one value from a predetermined list of allowable values.
3. (Previously Presented) A voice compression apparatus as recited in claim 2, wherein the analysis module is selected from the group of voice encoders consisting of linear predictive coders, mixed-excitation linear prediction coders, harmonic coders, and multi-band excitation coders.
4. (Original) A voice compression apparatus as recited in claim 2, wherein said superframe encoder includes at least two parametric processing modules selected from the group of parametric processing modules consisting of pitch smoothers, bandpass voicing smoothers, linear predictive quantizers, jitter quantizers, and Fourier magnitude quantizers.

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5. (Original) A voice compression apparatus as recited in claim 2, wherein said superframe encoder includes a vector quantizer wherein pitch values within a superframe are vector quantized with a distortion measure responsive to pitch errors.

6. (Original) A voice compression apparatus as recited in claim 2, wherein said superframe encoder includes a vector quantizer wherein pitch values within a superframe are vector quantized with a distortion measure responsive to pitch differentials as well as pitch errors.

7. (Previously Presented) A voice compression apparatus as recited in claim 2, wherein said super-frame encoder includes a quantizer of linear prediction parameters, wherein quantization is performed with a codebook-based interpolation of linear prediction parameters that employ different interpolation coefficients for each linear prediction parameter, and wherein said quantizer operates in closed loop mode to minimize overall error over a number of frames.

8. (Original) A voice compression apparatus as recited in claim 7, wherein said quantizer is capable of performing a line spectral frequency (LSF) quantization using said codebook-based interpolation.

9. (Original) A voice compression apparatus as recited in claim 8, wherein said codebook is created by means of a training database operated on by a centroid-based training procedure.

10. (Original) A voice compression apparatus as recited in claim 2, wherein said superframe encoder includes a pitch smoother wherein calculations are based on an onset/offset classifier.

11. (Original) A voice compression apparatus as recited in claim 2, wherein said superframe encoder includes a pitch smoother wherein pitch trajectory is calculated using a plurality of voicing decisions.

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12. (Previously Presented) A voice compression apparatus as recited in claim 11, wherein said pitch smoother classifies frames into onset and offset frames based on at least four waveform feature parameters selected from the group of waveform feature parameters consisting of energy zerocrossing rate, peakiness, maximum correlation coefficient of input speech, maximum correlation coefficient of 500 Hz low pass filtered speech, energy of low pass filtered speech, and energy of high pass filtered speech.

13. (Canceled)

14. (Currently Amended) A voice compression apparatus as recited in claim 13 ~~2~~, wherein said bandpass voicing smoother performs smoothing by modifying the cutoff frequency of a frame as a function of the cutoff frequencies of neighboring frames and the average frame energy.

15. (Original) A voice compression apparatus as recited in claim 2, further comprising means for compressing aperiodic flag bits for each frame in a superframe into a single bit per superframe, which bit is created based on the distribution of voiced and unvoiced frames within the superframe.

16. (Original) A voice compression apparatus as recited in claim 2, wherein said superframe encoder includes a plurality of quantizers for encoding parametric data into a set of bits, wherein at least one of said quantizers employs vector quantization to represent interpolation coefficients.

17. (Original) A voice compression apparatus as recited in claim 2, wherein a superframe is categorized into one of a plurality of coding states based on the combination of voiced and unvoiced frames within the superframe, and wherein each of said coding states is associated with a different bit allocation to be used with the superframe.

18. (Previously Presented) A voice compression apparatus, comprising:
(a) a superframe buffer for receiving multiple frames of voice data;

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(b) a frame-based analysis module for determining a set of voice data parameters for said voice data; and

(c) a super-frame encoder for receiving a unquantized voice data parameters for groups of frames within a superframe, said superframe encoder comprising:

(i) a pitch smoother for determining pitch and U/V decisions for each frame of the superframe and for extracting parameters needed for frame classification into onset and offset frames,

(ii) a bandpass voicing smoother for determining bandpass voicing strengths for the frames within the superframe and for determining cutoff frequencies for each frame, and

(iii) a parameter quantizer and encoder for quantizing and encoding voicing parameters received from said analysis module, said pitch smoother, and said bandpass voicing smoother into a set of bits and encoding said bits into an outgoing digital bitstream for transmission.

19. (Canceled)

20. (Currently Amended) A method of decoding a parametric voice encoded data stream into an audio voice signal comprising the steps of:

(a) buffering a received parametric voice data stream having a plurality of pitch periods;

(b) constructing an estimated spectrum of excitation within each pitch period by breaking down the frequency spectrum into regions based on a cutoff frequency, wherein said construction comprises the steps of:

(i) computing a Fourier magnitude for each region, wherein the resultant computed Fourier magnitude for at least one of said regions is then scaled by a gain factor computed for that region,

(ii) computing phase within each region, wherein the resultant phase for at least one of said regions has been modified by use of a weighted random phase, and

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(iii) converting said Fourier magnitude and said phase within each region to a time domain representation by the computation of an inverse discrete Fourier transform;
and

(c) generating an analog voice signal from said time domain representation;

wherein said regions into which the frequency spectrum is broken down comprise:

a lower region wherein Fourier magnitudes directly determine the spectrum;

a transition region wherein Fourier magnitudes are scaled down by a linearly decreasing weighting factor that drops from unity to a nonzero positive value dependent on the cutoff frequency of the current frame; and

an upper region wherein Fourier magnitudes are scaled down by a weighting factor depending on the cutoff frequency of the current frame.

21. (Canceled)

22. (Canceled)

23. (Canceled)

24. (Original) A vocoder method for encoding digitized voice into parametric voice data, comprising the steps of:

(a) loading multiple frames of digitized voice into a superframe buffer;

(b) encoding digitized voice within each frame of the superframe buffer by parametric analysis to produce frame-based parametric voice data;

(c) classifying frames as onset frames and offset frames by calculating pitch and U/V parameters within each frame of the superframe;

(d) determining a cutoff frequency for each frame within the superframe by calculating a bandpass voicing strength parameter for the frames within the superframe buffer;

(e) collecting a set of superframe parameters from the parametric analysis, frame classification, and cutoff frequency determination steps for the group of frames within the superframe;

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(f) quantizing the superframe parameters into discrete values represented by a reduced set of data bits that form quantized superframe parameter data; and

(g) encoding quantized superframe parameter data into a data stream of superframe-based parametric voice data that contains substantially equivalent voice information to the frame-based parametric voice data, yet at a lower bit per second rate of encoded voice.

25. (Canceled)

26. (Previously Presented) A method of encoding an audio voice signal comprising: receiving a superframe comprised of a plurality of frames of voice data corresponding to the audio voice signal;

determining for each frame in the superframe a set of unquantized voice data parameters;

determining pitch and U/V decisions for each frame in the superframe, and extracting parameters for frame classification from each frame in the superframe;

determining bandpass voicing strengths and cutoff frequencies for the frames within the superframe; and

quantizing the voice data parameters, pitch, U/V decision, frame classification, bandpass voicing strengths and cutoff frequencies into a set of bits and encoding the set of bits.

27. (Previously Presented) A computer-readable medium having thereon computer-readable instructions for performing a method of encoding an audio voice signal comprising the steps of:

receiving a superframe comprised of a plurality of frames of voice data corresponding to the audio voice signal;

determining for each frame in the superframe a set of unquantized voice data parameters;

determining pitch and U/V decisions for each frame in the superframe, and extracting parameters for frame classification from each frame in the superframe;

determining bandpass voicing strengths and cutoff frequencies for the frames within the superframe; and

quantizing the voice data parameters, pitch, U/V decision, frame classification, bandpass voicing strengths and cutoff frequencies into a set of bits and encoding the set of bits.

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28.-30. (Canceled)

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